LARVAMIMIDAE, A NEW FAMILY OF MITES (ACARI : DERMANYSSOIDEA) ASSOCIATED WITH ARMY ANTS [1].

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TAXONOMY
DERMANYSSOIDEA

ABSTRACT : A new family of dermanyssoid mite, Larvamimidae, is described on the basis of four new species of mimics of army ant larvae. *Larvamima*, a new genus, is described as the type genus of this monogeneric family.

TAXONOMIE
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ZUSAMMENFASSUNG : Eine neue Familie Dermanyssoid-Milben, Larvamimidae, wird beschrieben aufgrund von vier neuen Arten, welche die Larven von Wanderameisen imitieren. *Larvamima* wird als Typus dieser neuen Gattung der monogenerischen Familie beschrieben.

TAXONOMIE
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RÉSUMÉ : Une nouvelle famille d'acariens dermanyssoides, les Larvamimidae, est décrite d'après quatre espèces nouvelles imitant les larves des fourmis combattantes. Le nouveau genre *Larvamima* est désigné comme genre type de cette famille monogénérique.

VITZTHUM (1942) presented a classification dividing the Laelapidae into 13 subfamilies, most of which were elevated into nine families by BAKER and WHARTON (1952). EVANS (1957), following VITZTHUM's direction, returned many of these families to the subfamily level within the Laelapidae except for two, the Podicinidae and Phytoseiidae. Since EVANS' work, there has been a slow but obvious trend to reclassify most of EVANS' subfamilies as families. However, most of the research has dealt with species parasitic on vertebrates, and the free-living mites and insect associates have received little attention. As a result, the following 14 dermanyssoid families usually are recognized (KRANTZ 1978) : Laelapidae (free-living, paraphages, and vertebrate parasites); Dermanyssidae (vertebrate parasites); Hystrichonyssidae (vertebrate parasites); Macronyssidae (vertebrate parasites); Entonyssidae (reptile parasites); Omentolaelapidae (reptile parasites); Ixodorhynchidae (reptile parasites); Rhinonyssidae (bird parasites); Halarachnidae (mammal parasites); Dasyponyssidae (mammal parasites); Manitherionyssidae (mammal parasites); Spelaeorhynchidae (bat parasites); Spinturnicidae (bat parasites); and Varroidae (honey bee parasites). RADOVSKY (1969, 1985) proposed that the above families, with the exception of Spelaeorhynchidae, evolved from primitive Laelapidae.

Although the above families, except for Spelaeorhynchidae, appear to have a common ancestor and are, hence, monophyletic, some questions continue to persist as to the systematic level of each family

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and the subfamilial taxa within each. This is probably due to the lack of immature stages available for study and the complications arising from interpretation of convergent structures. Convergence can occur both through expression of acquired characters and through character loss. In many instances, it is the recognition of these convergences and patterns of convergence coupled with the use of a limited number of apomorphic characters that has resulted in the restoration of many of the previously mentioned subfamilies to family status. A few of the major convergent modifications (RADOVSKY 1969, 1985) to be considered in dermanyssoid mites include : reduction of body shield sclerotization, reduction of the peritreme, loss of claws, reduction of the fixed digit of the chelicera in at least the female, appearance of the 3-tined palpal apotele, loss of the tritosternum, reduction of corniculi, loss of deutosternal denticles, retention of immature chaetotaxy on various structures, and an increase or decrease of leg length.

As indicated previously, only a single family (Varroidae) in the Dermanyssoidea has been known to be associated exclusively with invertebrates. A second family of invertebrate associates, Larvamimidae, is described, below. This family contains a single genus and four species, all new, and continues the trend of defining dermanyssoid families by the recognition of new combinations of convergent modifications. This new family, comprised of army ant larval mimics, most likely also evolved from laelapid ancestors.

LARVAMIMIDAE NEW FAMILY

Diagnosis : Dermanyssoid mites lacking idiosomal sclerites ; body neosomatic (female), pseudosegmented and hypertrichous ; legs short, 2nd and 3rd pairs separated, setal number reduced and probably neotenic, tibia I with 4 dorsal setae, male tarsus I with small ventral spur, claws absent and ambulacra well-developed ; female chelicera with fixed digit greatly reduced, movable digit dentate (Fig. 4) ; male chelicera with reduced digits, spermatodactyl entirely fused to movable digit but extending beyond digits (Fig. 1) ; palpal apotele 3-tined ; corniculi hornlike ; tritosternum absent; male genital orifice in notched edge of presternal area (Fig. 2) ; female genital orifice transverse, opposite posterior limits of legs III ; stigmata and peritremes greatly reduced ; associated with army ants.

Type Genus : *Larvamima* n. g.

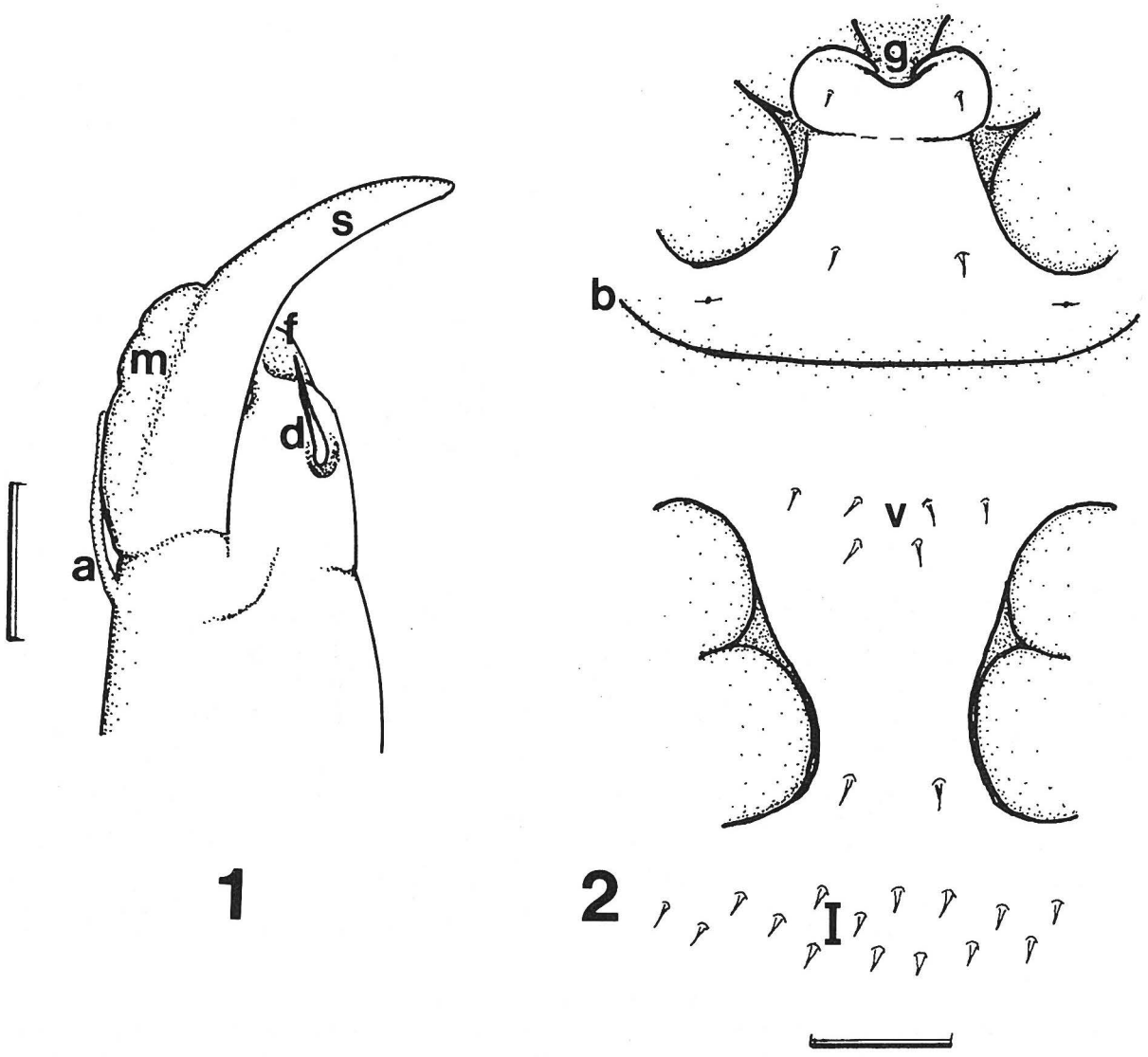
Larvamima new genus

FEMALE

Dorsum : pseudosegmented with divisions between legs II and III (Fig. 5), 1 division between podosoma and opisthosoma, and 2 to 3 divisions in anterior opisthosoma; setae short ; color white when alive.

Venter : anterior sternal shield " vestiges " containing sternal setae I, opposite legs I ; sternal setae II at level of posterior coxae II ; sternal setae III and IV obscured by secondary setae, opposite legs III ; only 1 pair of sternal lyriform pores, adjacent to coxae II; with a pair of short genital setae just posterior to genital orifice ; opisthosoma with anterior ventral setae in fields within pseudosegments, distances between setae increasing with degree of neosomy, with pair of paranal and a posterior postanal seta adjacent to ventrally located anus.

Gnathosoma (Figs. 3,4) : tectum simple (lacking denticulations), triangular in shape ; fixed cheliceral digit greatly reduced or absent, movable digit dentate with 2 conspicuous teeth and terminal hook, with lateral basal flange (1) for guiding chelicerae over the internal malae and between corniculi ; chelicera with large dorsolateral seta (d) and small pilus dentilis dorsal to movable digit articulation ; palps short, chaetotaxy 1-4-5-10-11 (neotenic in terms of gamasine holotrichous pattern), with 2 enlarged dorsoterminal tibial setae ; 3rd palpal apotele tine small ; hypostome with 2 of 3 setae reduced to campaniform shape, gnathosomal setae present ; hypognathal groove poorly



FIGS. 1-2 : *Larvamima marinae*, n. sp., male.

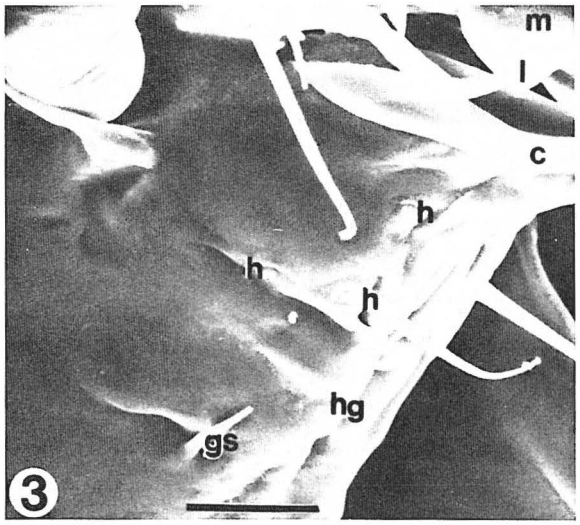
1. — chelicera (lateral view). Scale bar = 10 μm. 2.— sternal region. Scale bar = 50 μm.

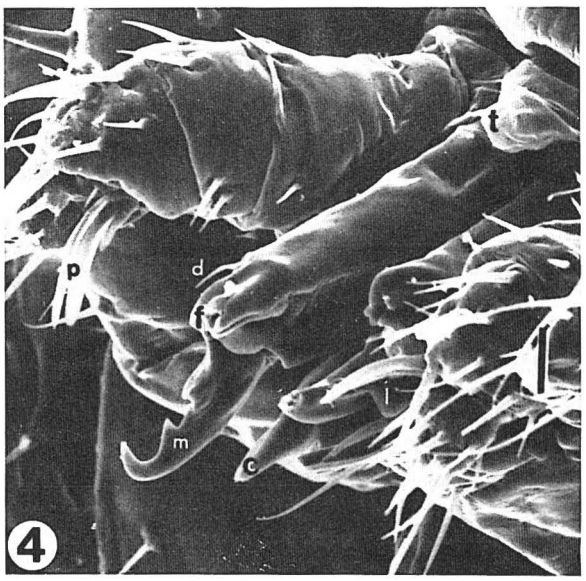
a, arthrodial process ; b, pseudosegmental division ; d, dorsolateral seta ; f, fixed cheliceral digit ; g, genital orifice ; m, movable cheliceral digit ; s, spermatodactyl ; v, ventral setae III, IV and secondary setae ; I, opisthosomal setal field number I.

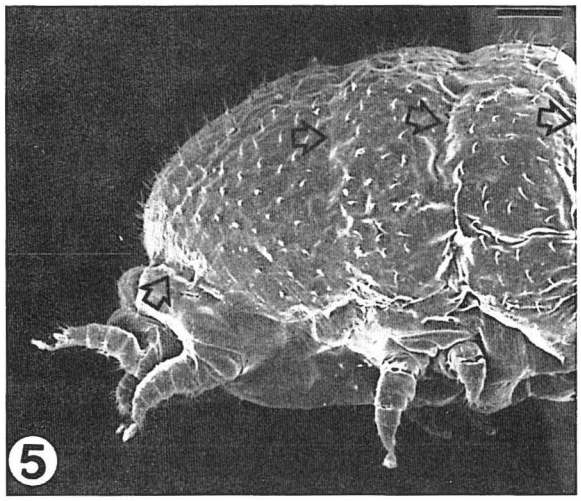
defined, lacking denticles, corniculi grooved dorsally for stylet movement.

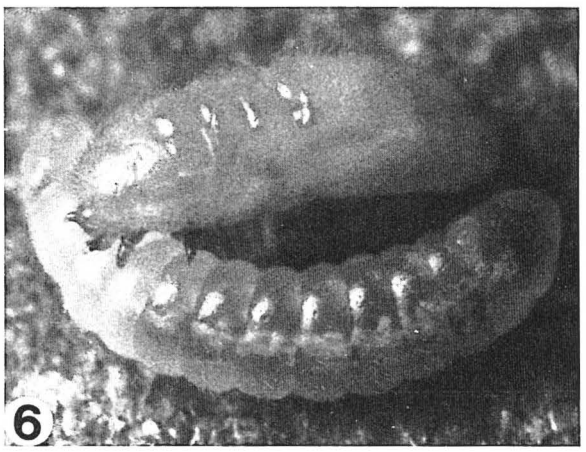
Legs : Ambulacra developed as pads ; legs II-IV with nearly complete basitarsal separations ; setal number reduced, with chaetotaxy as follows :

	Leg I	*Leg II*	*Leg III*	*Leg IV*
Coxa	2	2	2	2
Trochanter	6	5	5	5
Femur	$2\,\frac{2}{1'3}\,2$	$2\,\frac{2}{1'2}\,2$	$1\,\frac{1}{1'0}\,1$	$1\,\frac{1}{1'0}\,1$
Genu	$1\,\frac{2}{2'1}\,1$	$1\,\frac{2}{1'1}\,1$	$1\,\frac{2}{1'0}\,1$	$1\,\frac{2}{1'0}\,1$
Tibia	$1\,\frac{2}{2'1}\,1$	$1\,\frac{1}{1'1}\,1$	$1\,\frac{1}{1'1}\,1$	$1\,\frac{1}{1'1}\,1$









FIGS. 3-6 ; *Larvamima* females.

3. — *L. marianae* n. sp., palpcoxal region. Scale bar = 10 μm. 4. — *L. schneirlai* n. sp., gnathosoma. Scale bar = 10 μm. 5. — *L. marianae* n. sp., lateral view of podosoma. Scale bar = 100 μm. 6. — *L. schneirlai* n. sp., mite crawling upon *Eciton* larva (photographed by C. W. RETTENMEYER).

c : corniculus ; d : dorsolateral seta ; f : fixed cheliceral digit ; gs : gnathosomal seta ; h : hypostomal seta ; hg : hypognathal groove ; l : lateral flange of chelicera ; m : movable cheliceral digit ; p : palpal apotele ; t : tectum ; arrows : pseudosegmental divisions.

MALE

Similar to female except as follows :

Dorsum : Pseudosegments present but less obvious in opisthosomal region of the body ; little neosomy.

Venter : podosomal and secondary and opisthosomal ventral setal number vary with species.

Gnathosoma : Cheliceral fixed digit asymmetrical, edentate ; movable digit of chelicerae same length as fixed digit, edentate and fused to laterally positioned spermatodactyl (Fig. 1) ; doubled arthrodial processes (a) arise ventrally from proximal end of 2nd segment, 2/3rds longer than digit length.

Type Species. Larvamima marianae n. sp.

Larvamima marianae n. sp.
(Fig. 7)

FEMALE :

Body length moderate, 1200-1700 μm (podosoma 370-530 μm, opisthosoma 900-1210 μm) ; opisthosoma with 2 short pseudosegments plus terminal section ; posterior end narrowed.

Dorsum : dorsal setae enlarged near base and rapidly narrowed terminally, short (18-35 μm) ; peritreme 34-36 μm in length.

Venter (Fig. 7) : sternal setae short (Table I) ; sternal setae III, IV and 3 pairs secondary setae in row of 4 and posterior row of 2 at level of coxae III, 15-30 μm long ; genital setae short (16-22 μm) ; opisthosomal field number I with 14-18 setae in 2 rows, narrowly grading into dorsal setal area ; opisthosomal field number II with 19-28 short setae (19-25 μm long) grading into dorsal setal field ; opisthosomal field number III not defined ; remaining opisthosomal setae well separated from field number II, short (16-24 μm), more sparse posteriorly with few posterior to anus ; anal setae longer (35-40 μm) than adjacent ventral setae.

Legs : Comparative length normal for genus ; leg I 240 μm long.

Gnathosoma : palpocoxal (gnathosomal) setae 16-20 μm long.

MALE

Body length short, 690-910 μm (podosoma 360-460 μm, opisthosoma 380-440 μm) ; opisthosomal pseudosegments ill-defined.

Dorsum : dorsal setae short, 6-9 μm.

Venter (Fig. 2) : sternal setae III, IV and secondary setae in 2 rows of 6 (4,2) and 7-8 μm long ; opisthosomal field number I with 14-16 setae (6-7 μm long) ; setae in opisthosomal fields II and III undifferentiated from remaining ventral setae ; anal setae longer (17-33 μm) than ventral setae.

Legs : Tarsus II with spur near terminal end of segment.

Measurements	*L. marianae*		*L. schneirlai*		*L. carli*		*L. cristata*	
	♀	♂	♀	♂	♀	♂	♀	♂
Body length	1200-1700	690-910	745-1845	675-810	2130-2360	—	2500	—
Dorsal seta length	18-35	6-9	38-58	7-10	90-165	—	65-85	—
Sternal seta I length	15-25	7-8	20-40	11-12	81-85	—	50	—
Sternal seta II length	15-30	7-8	30-60	9-12	79-81	—	53-54	—
Sternal seta III, IV and secondaries length	15-30	7-8	30-69	7-10	78-81	—	58-64	—
Genital (♀) or sternal seta (♂) length	16-22	6-7	32-60	8-10	19-20	—	75-77	—
Opisthosomal setae length field I	16-30	6-7	25-50	7-10	90-95	—	98-102	—
Opisthosomal setae length field II	19-25	6-7	25-45	6-8	90-110	—	90-95	—
Opisthosomal setae length field III	—	—	—	—	—	—	90-95	—
Remaining opisthosomal setae length	16-24	6-7	35-60	6-9	85-125	—	80-98	—
Anal setae length	35-40	17-33	38-45	20-29	40-45	—	20-25	—

TABLE I : Measurements (in micrometers) of new species of *Larvamima*

TYPES

Holotype female in alcohol with the following data : ECUADOR : Oriente 00°24′ S, 76°36′ W Limoncocha ; 11.XI.1967 ; C. W. & M. E. RETTENMEYER ; Host : *Eciton hamatum*, Colony E-538. Allotype male from same locality but collected on 8.XI.1967 from *E. mexicanum*, Colony E-584 ; Slide

No. RE-1,012. Holotype female and allotype male are deposited in U.S. National Museum. Paratypes from the same locality and hosts and from *E. leucanoides* are deposited in the British Museum (Nat. History) and author's collection.

This species is named after one of the collectors, MARIAN RETTENMEYER.

LOCALITIES AND HOSTS

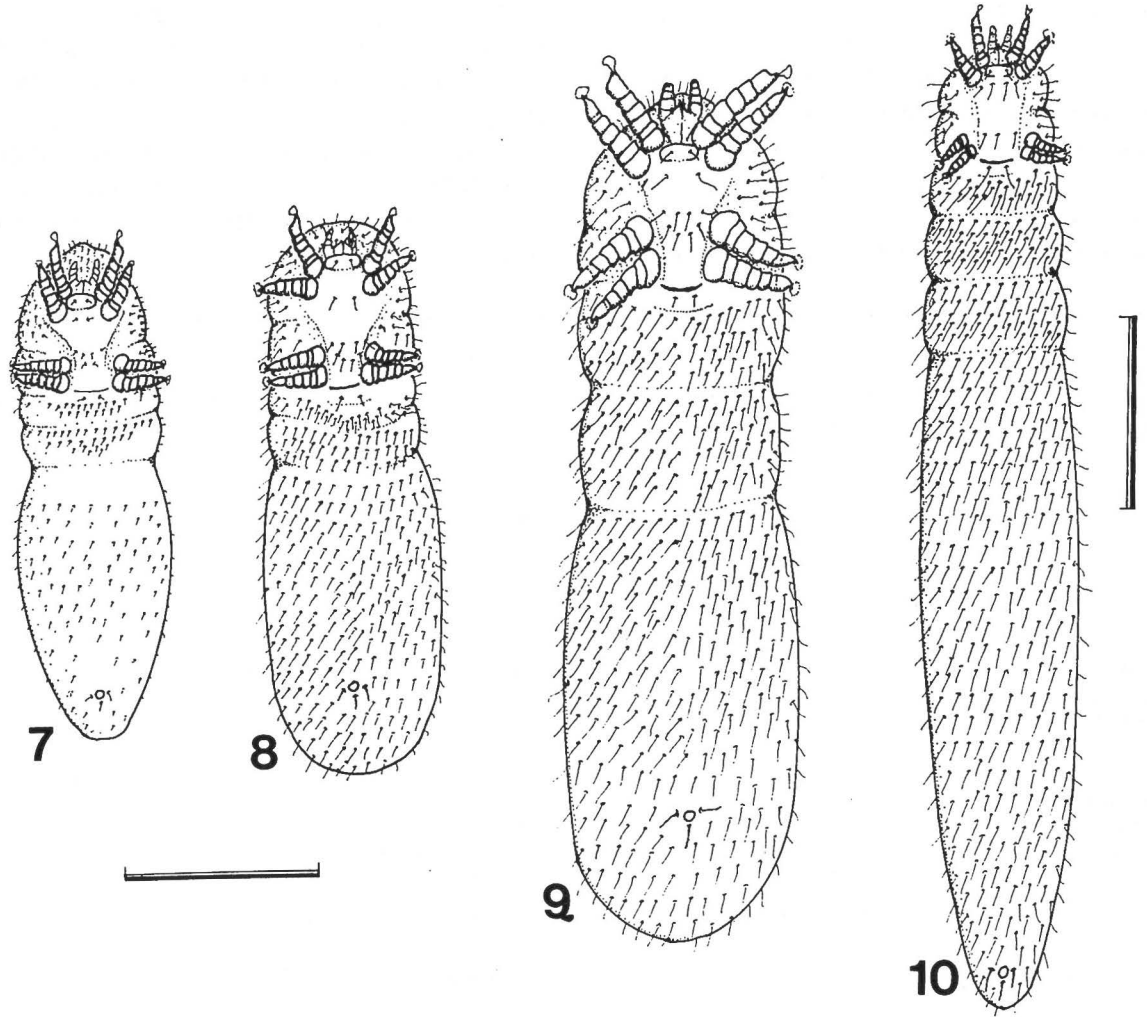
A single specimen of this species has also been collected in Darien Province, Panama by T. C. SCHNEIRLA and from the type locality by C. W. RETTENMEYER with *E. rapax* as host.

Larvamima schneirlai n. sp.
(Fig. 8)

FEMALE

Body length moderate, 745-1845 μm (podosoma 370-620 μm, opisthosoma 360-1280 μm); opisthosoma with 2 short pseudosegments plus terminal region; posterior end round in shape.

Dorsum : Dorsal setae moderate length (38-58 μm), more rapidly tapering than those of *L. carli*; peritreme length 34-35 μm.



FIGS. 7-10; *Larvamima* females, ventral views. Scales bars = 500 μm
7. — *L. marianae* n. sp. 8. — *L. schneirlai* n. sp. 9. — *L. carli* n. sp. 10. — *L. cristata* n. sp.

Venter (Fig. 8) : Ventral setae short to moderate (Table I) ; sternal setae III, IV and 1 to 2 pairs of secondary setae in either 2 (4, 2) or 3 (4,2,2) rows at level of coxae III ; genital setae moderate in length (32-60 μm) ; opisthosomal field number I with 25-30 moderate length setae (25-50 μm) in 2 rows, broadly meeting dorsal setae ; opisthosomal field number II with 28-30 moderate length setae, broadly meeting dorsal setae and nearly merged with field number I in less neosomatic specimens ; opisthosomal field number III not defined separately ; remaining opisthosomal setae short to moderate (35-100 μm) in length, uniformly distributed with many posterior to anus ; anal setae same size as adjacent ventral setae (38-45 μm).

Legs : Comparative length normal for genus, leg I 245 μm long.

Gnathosoma : Palpotarsal (gnathosomal) setae 16-22 μm long.

MALE

Body length short, 675-810 μm long (podosoma 430-410 μm, opisthosoma 360-450 μm) ; opisthosomal pseudosegments poorly defined.

Dorsum : Dorsal setal length 7-10 μm.

Venter : Sternal setae III, IV and secondary setae in 3 variable rows of 8 (3,3,2) (4,2,2) (4,3,1) and 7-10 μm long ; opisthosomal field number I with 23-29 setae meeting dorsals and 7-10 μm long ; opisthosomal field number II and III inseparable from remaining ventral setae, 6-8 μm long ; anal setae longer (20-29 μm long) than adjacent ventral setae, 20-29 μm long.

Legs : Tarsus II with spur near tip.

TYPES

Holotype female with the following data : PANAMA : Rio Pequeni ; 12.XII.1947 ; T. C. SCHNEIRLA ; Host : *Eciton hamatum*, Colony 48 PH-2 ; Slide No. RE-1,025. Allotype male with same data as holotype except Slide No. RE-1,027. Holotype female and allotype male are deposited in the U.S. National Museum. Paratypes from the same locality and host species are deposited in the British Museum (Nat. History) and in author's collection.

This species is named for the collector, T. C. SCHNEIRLA.

LOCALITY AND HOSTS

The species has also been collected from the type host at Pirre River, Darien Prov., Panama by T. C. SCHNEIRLA and on Barro Colorado Island, Panama Canal Zone by C. W. and M. E. RETTENMEYER with *E. mexicanum* and *E. burchelli* as hosts.

Larvimima carli n. sp.

(Fig. 9)

FEMALE

Body length long, 2130-2360 μm (podosoma 580-600 μm, opisthosoma 1530-2025 μm) ; opisthosoma with 2 short pseudosegments plus terminal region ; posterior end round.

Dorsum : Dorsal setae gradually tapering and long (90-165 μm) ; peritreme 38-40 μm long.

Venter (Fig. 9) : Sternal setae long (Table I) ; sternal setae III, IV and 2 pairs of secondary setae in 2 rows (4,2) at level of coxae III ; genital setae short (19-20 μm) ; opisthosomal field number I with 40-50 long (90-95 μm) setae in multiple rows ; opisthosomal field number II with 40-50 setae (90-110 μm) meeting dorsals ; opisthosomal field number III not defined (no pseudosegment) ; remaining opisthosomal setae long (85-125 μm) and uniformly distributed, many posterior to anus ; anal setae 1/2 length of adjacent ventral setae.

Legs : Comparative length normal for genus, leg I 270 μm long.

Gnathosoma : Palpocoxal (gnathosomal) setae 30 μm long.

MALE : Unknown.

TYPES

Holotype female with the following data : PANAMA : Barro Colorado Is., Canal Zone ;

26.VII.1956 ; C. W. and M. E. RETTENMEYER ; *Eciton hamatum*, Colony E-221 ; Slide No. 1,055. Paratype female in alcohol from above locality and collectors but from *E. burchelli* ; 17.III.1955. Holotype deposited in U.S. National Museum and paratype in author's collection.

This species is named for one of the collectors, CARL W. RETTENMEYER.

LOCALITY AND HOSTS

This species is known only from the type locality and hosts of holotype and paratype.

Larvamima cristata n. sp.
(Fig. 10)

FEMALE

Body length long, 2500 μm (podosoma 300 μm, opisthosoma 2210 μm) ; opisthosoma with 3 pseudosegments plus terminal posteriorly tapered region.

Dorsum : Dorsal setae gradually tapering, moderate to long (65-85 μm) ; peritreme 27 μm long.

Venter (Fig. 10) : Sternal setae moderate length (Table I) ; sternal I and II in horizontal row ; sternal setae III and IV represented by 3 setae (58-64 μm) in horizontal row, secondary setae absent ; genital setae long (75-77 μm) ; opisthosomal field number I with 24-30 long setae (98-102 μm) broadly grading into dorsal field ; opisthosomal field number II with 30-40 long setae (90-95 μm), broadly grading into dorsal field ; opisthosomal field number III with numerous long setae, broadly grading into dorsal field ; remaining opisthosomal setae long, uniformly distributed but few posterior to anus ; anal setae short (20-25 μm), 1/3 length of adjacent ventral setae.

Legs : short and slender for genus, leg I 156 μm long.

Gnathosoma : Palpocoxal (gnathosomal) setae 12 μm long.

MALE : Unknown

TYPE

Holotype female with the following data : ECUADOR : Oriente, Limancocha ; 15.VI.1967 ; C. W. RETTENMEYER ; Host : *Neivamyrmex cristatus*, Colony E-550. Holotype deposited in the U.S. National Museum.

The species is named for its army ant host species.

LOCALITY AND HOSTS

This species is known only from the type locality and host.

BIOLOGY

RETTENMEYER (1961) reported that these adult mites live in low populations within army ant colonies ; the ratio was 1:5334 between mites and army ant larvae collected from bivouacs on Barro Colorado Island, Panama, with *E. hamatum* having the most mites. RETTENMEYER also observed ants moving the mites ; hence, the mites are most likely carried similarly to the larvae, which they resemble, during the daily emigrations of the colony. RETTENMEYER observed and photographed (Fig. 6) a mite walking upon ant larvae, eliciting no abnormal reactions from the larvae or adults in the vicinity. Based on cheliceral structure, it is hypothesized that the mites feed on their larval hosts.

These mites are apparently undetected as larval mimics within the colony. They are similar in shape to the larvae, and the numerous short body setae probably give the proper tactile " feeling " when tested by ant workers. Because ant larvae grow significantly during development, deception also necessitates that mite size remain within the size variation of ant larvae. SCHNEIRLA (1971) measured size increases over time of *Eciton* larvae of major and minor workers, and these figures were compared with mite sizes available. A correlation was found between the female mite lengths and the

army ant larvae. Mite size need not correlate with size increases for a single caste but must correlate with members of some caste at all times. Keeping this point in mind, the measurement indicated that female mites become too short (at least for those mites available) for the major caste larvae after day 5 of the colony in its nomadic stage (when larvae are present), but remain in the acceptable size range of some of the minor larvae until day 18, or when larval development often is completed. Also, measurements of distances between body setae revealed that the intervals were greater for larger female mites, suggesting that stretching of the exoskeleton occurs with increases in body length. In contrast to the female mites, no increases in size or spacing between setae was noted in male mites.

Three female *L. schneirlae* and one *L. marianae* were gravid ; however, only a single egg per female was observed. Eggs were orange in alcohol preserved specimens, lacked a developing embryo, and varied from 268 to 330 μm in length. Although the four eggs represent an admittedly small sample, the single large unembryonated egg per female suggests an oviparous reproduction scheme coupled with a low mortality rate during development.

Other mites, although distantly related, also resemble ant larvae. The pyemotid *Perperipes ornithocephala* Cross (Cross 1965) has also been collected from bivouacs of *Eciton* army ants by C. W. Rettenmeyer on Barro Colorado Island, Panama, and an undescribed astigmatid mite has been collected by C. L. and A. S. Rotramel from the myrmecine *Acanthomyops* sp. from Indiana, U.S.A. Although these mites have similar body shapes and appear to represent convergences in evolution, the bases for the similarities are diverse, i.e. *Larvamima* appears to represent neosomy whereas the above cited pyemotid represents true physogastry and the astigmatid condition remains uncertain.

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